POST-DIVE DETECTION OF ENDOTHELIAL DYSFUNCTION AND BUBBLES AS MARKERS OF DECOMPRESSION STRESS IN SCUBA DIVERS

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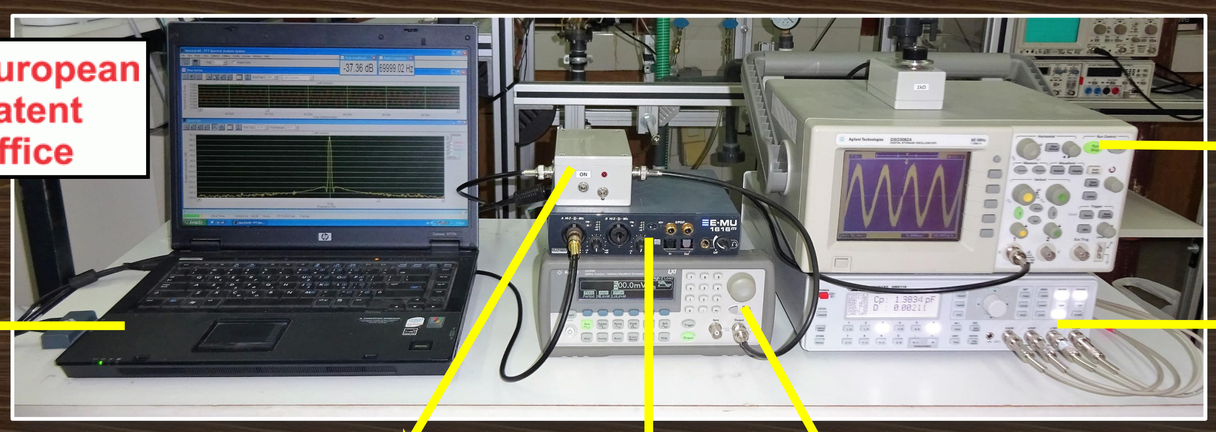
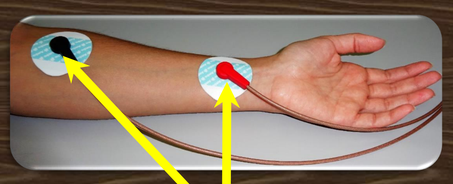
INTRODUCTION

Decompression stress is the stress on the body of scuba divers while ascending from large depths of water. It can cause Decompression Sickness (DCS) with symptoms varying from joint pain and rashes to paralysis and death. Stress markers of interest include **post-dive detection of bubbles** as well as **arterial endothelial dysfunction**. Ultrasound method is considered the "*gold*" standard for the evaluation of these markers. Although the method is simple, many problems arise in real use. These problems are mostly related to the human factor involved in ultrasound probe handling and interpretation of acquired measurements. This work investigates whether the aforementioned stress markers can be effectively assessed employing a non-invasive and easy to operate electrical impedance device.

MATERIALS & METHODS

Herein, post-dive detection of bubbles and arterial endothelial dysfunction are investigated by means of an **electrical impedance spectroscopy device** (*European Patent Office, 3005942 A1, 2015*), which reads bioelectrical signals of **exceptional high sensitivity and accuracy** using simple ECG-type electrodes placed at the forearm site of humans.





A test campaign is performed in the **NEMO 33** swimming pool in Brussels, Belgium.

Electrical measurements

Ultrasound measurements

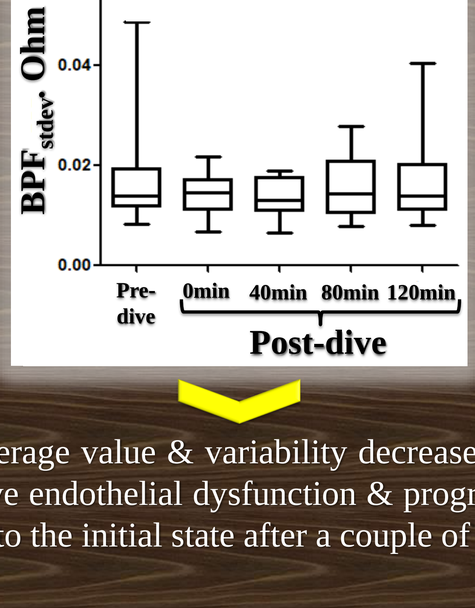
- ***17*** volunteer divers
- Well-defined dive profile: depth: ***33m*** / duration: ***20min*** / T_{water}: ***31°C***
- ***2h*** post-dive study of endothelial functionality and bubbles presence
- Validation against ultrasound (***Doppler***) measurements

RESULTS & DISCUSSION

Five electrical signals are recorded for each diver: **1 pre-dive signal** and **4 post-dive signals** with an **interval of 30 minutes**. It is demonstrated that two distinct frequency components of acquired signals can be exploited to assess decompression stress.

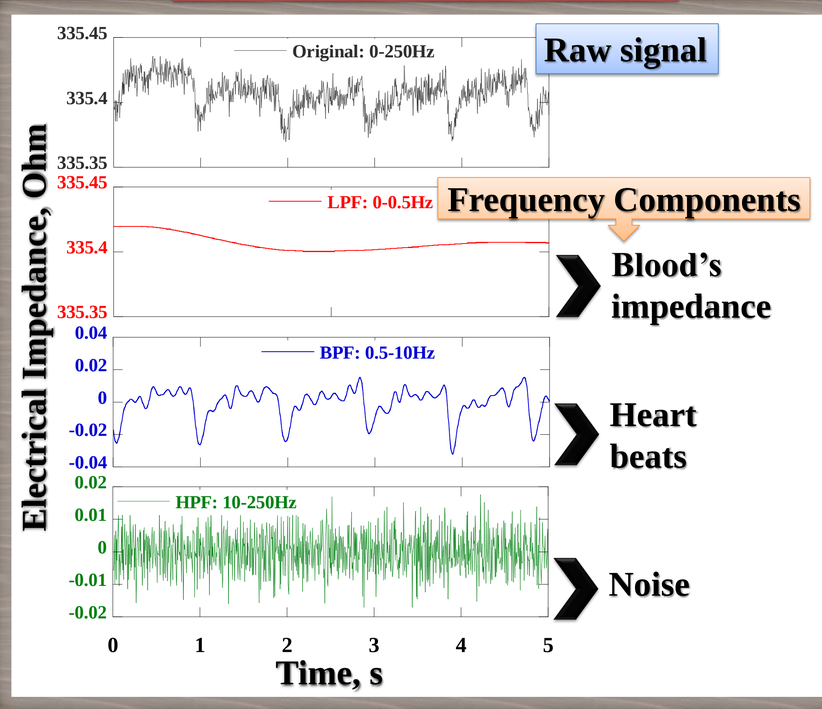
Detection of arterial endothelial dysfunction

BPF



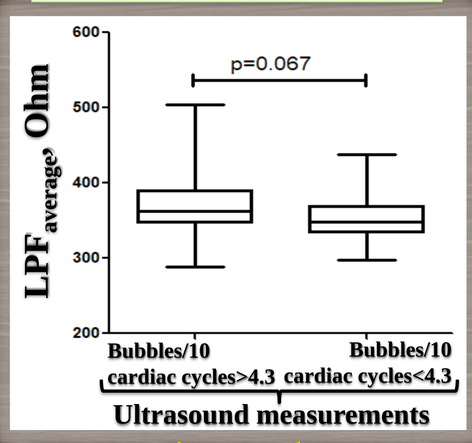
BPF average value & variability decreases due to post-dive endothelial dysfunction & progressively returns to the initial state after a couple of hours

Indicative electrical signal



LPF

Detection of bubbles



- ROC analysis showed that LPF is higher when bubbles/10 cycles > 4.3
- Mann-Whitney non-parametric test shows p=0.067 (only 6.7% possibility that LPF variation is due to chance)

ACKNOWLEDGEMENTS

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